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ALTERATIONS IN PLEASANTNESS BUT NOT ACTIVATION WHEN LONG-TERM MEMORIES ARE RECONSTRUCTED DURING CONTEXTUAL VERSUS NONCONTEXTUAL SETTINGS [1, 2]

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Summary.—Because the dorsomedial thalamus is a major input to the prefrontal cortices, the reconstruction of experience (episodic memory) that is maximally dependent upon this subcortical structure should be influenced by one of its major correlates, hedonistic tone. University men and women (*ns* = 20) were shown two brief videotapes of muricide and copulation among male rats during a lecture concerning instinctual behaviors. Two weeks later the subjects were asked to recall (written narratives) all of the details of the videotapes when they were in either the same or a different context. Although both groups generated similar numbers of words and employed words with comparable activation scores, the group who reconstructed the experiences outside of the context used words with significantly lower (*eta* = 0.59) pleasantness scores relative to the group who remembered the videotapes within the same setting.

Human memories are multifactorial phenomena. A person's recall of a rote-memorized event such as a multiplication table involves different processes than the recollection of when, where, and if experiences occurred with respect to the reference point: the self. Episodic recall emphasizes the temporal order of experiences and their spatial relationship within the person's phenomenological past. Because these processes are primarily dependent upon self-monitoring, organization, sequencing, and the capacity to discriminate fantasy, e.g., dreams or wishes, from more veridical occurrences, this subtype of memory is primarily associated with the functions and properties of the prefrontal lobes (Kolb & Whishaw, 1990).

A primary assumption of neurocognition is that behaviors are determined by those portions of the brain that are most metabolically active at any given time (Persinger, 1993). If reconstruction of the temporal order of experiences is associated with prefrontal activity, then the characteristics of episodic memory should be affected by the properties of any major structure whose input modulates the functions of these cerebral cortices. The dorsomedial group, a major aggregate of thalamic association nuclei, is the major diencephalic afferent; it receives a unique unidirectional input from the primary limbic substrate for the hedonistic polarity (pleasant vs unpleasant or

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reward vs punishment) of experience and memory: the amygdala. In addition to modulating temporal estimation and visuospatial memory (Squire, 1986), the dorsomedial thalamus mediates affective tone (Crosby, Humphrey, & Laurer, 1962). We have assumed that any memory which requires prefrontal activation should contain the neurocognitive signature of these functions of the dorsomedial thalamus and its inputs.

Along the continuum of experiential reconstruction, context-dependent memory and noncontext-dependent memory can be considered diametric oppositions (Tulving, 1983). Whereas memory in the former settings would involve stimulus-evoked experiences, recall in the latter setting would be totally dependent upon the organizational capacities of the prefrontal lobes. We hypothesized that the numbers of words to describe the memory for a brief series of unique (never experienced) events should not differ between context- and noncontext-dependent settings. However, given the prominent role of the (hedonistic) affective input (Crosby, *et al.*, 1962) from the dorsomedial thalamus into the prefrontal cortices during noncontextual recall, the words selected to describe the events would differ along the unpleasantness-pleasantness dimension but not along the passive-active dimension of the Dictionary of Affect in Language (Whissell, 1989). Considering the major influence of the dorsomedial thalamus upon prefrontal function, we predicted an effect size that should explain at least 25% of the variance, i.e., *eta* = 0.50, for these quantitative inferences of semantic mood.

To test this hypothesis, a total of 40 university men and women (20 each) between the ages of 20 and 30 years served as subjects. During their normal lecture period (evening course) while the topic of instinctual (ethological) behaviors was discussed, they viewed two videotapes. The first tape (2 min.) showed muricide (rats killing mice because of cholinergic activation in the former) while the second tape (2 min.) showed male rats mounting and pelvic-thrusting other male rats due to amygdaloid injury. These segments were selected as stimuli because the probability was extremely low that any of these behaviors had ever been witnessed previously by the subjects. Two weeks later, after the initial exposure, during the same time (the end of the normal lecture), half of the class was randomly selected, given sealed instructions (not to be opened until they arrived at their homes, i.e., within about one hour), and then disengaged by the usually pleasant departure sequence; these subjects were called the noncontextual group.

The other half of the class, the contextual group, were asked to stay for a brief period. When all of the first group had departed, the contextual group was exposed to the same set of stimuli. The specific noisy viewing stand and videorecorder was rolled into the lecture hall and placed at the front of the class. A brief sequence (30 sec.) was shown from each of two different tapes that contained similar presentations (but no killing or mount-

ing). Each subject read the instructions personally; these requested the subject write a precise description of every detail that had happened within the tapes two weeks earlier. The noncontextual group's instructions were identical except that they were told to imagine themselves in the classroom watching the video monitor before they began recalling the details of the videotapes.

The subjects returned their narratives within 24 hours. Each narrative was typed and the words were evaluated automatically by Whissell's Dictionary of Affect. The total numbers of scorable words, the weighted evaluative scores of the words, and the weighted activation scores for the words were calculated. Each narrative was also judged according to general compositional competence and organization. The primary design was a three-way analysis of variance with one within-subject level (evaluation vs activation) and two nonrepeated levels (context vs noncontext; men vs women). This multivariate analysis of variance and subsequent *post hoc* comparisons were all completed with SPSS software.

The results showed no statistically significant differences (all *df*s = 1,36) between gender ($F < 1.00$) or contexts ($F < 1.00$) for the means of the two mood dimensions (evaluation, activation combined); however, there was an interaction of sex by group ($F = 12.98$, $p < .001$) which was due to the more unpleasant and inactive ratings by the women in the noncontextual group (*M* and *SD* = 3.90 and 0.12) compared ($F_{3,36} = 6.68$) with the other three groups (4.07 and 0.10), who did not differ significantly from each other as indicated by Tukey's *post hoc* comparisons.

Our hypothesis was supported by the statistically significant interaction between type of word meaning (activity vs evaluation) and group ($F = 15.33$, $p < .001$). *Post hoc* analyses showed that the interaction was due primarily to the significant difference between evaluation scores for the noncontextual group (4.08 and 0.22) compared to the contextual group (4.39 and 0.23) while the differences between scores on the activity dimension were not statistically significant; *M*s and *SD*s = 3.77 and .20 and 3.88 and 0.24, respectively. The *eta* value (effect size) for the group differences for the evaluative scores was 0.59 ($F_{1,36} = 19.27$, $p < .001$). The differences between the evaluative and activity scores for the noncontextual group were significantly different ($t_{19} = 8.48$, $p < .001$) while these differences for the contextual group were only marginally significant ($t = 2.36$, $p < .05$).

Although the mean numbers of scorable words for the narratives for the contextual (*M* and *SD* = 11.2 and 3.8) and noncontextual (14.8 and 7.3) groups did not differ significantly ($F_{1,38} = 3.79$, $.05 < p < .10$), there was a qualitatively conspicuous difference between the groups. All of the members of the noncontextual (prefrontal) group used paragraph structures, elaborate phrases and clauses, and metaphors. All but two of the 20 members of the

contextual group employed short descriptors, fragmented phrases, and incomplete sentences. Metaphors were not employed.

Whereas the contextual narratives were primarily fragments of ideas, events, and phrases (a pattern that is commensurate with stimulus-evoked associations), the noncontextual narratives were well integrated and organized and contained persistent themes (a pattern that is commensurate with prefrontal categorization and organization). The results support our model that exclusive dependence upon prefrontal function to reconstruct the past rather than upon exposure to the actual situation in which the experience occurred (and in which it began consolidation) amplifies the hedonistic (unpleasant-pleasant) dimensions of that reconstruction because of the concomitant input from the dorsomedial thalamus.

The affective label associated with an experience should strongly influence the hedonistic dimensions of the words that are later employed for its reconstruction. One variant of the Whissell principle is that mood matching is as important as categorical congruity for the recognition of words by episodic memory. If the principle is applicable to the operations described in this study, then the words selected to reconstruct the experience would be accurate connotatively while the cognitive images and categorical classifications of these words could be quite inaccurate.

These results suggest that (1) quantitative assessment of the emotional dimensions of narratives may be a potential tool for differentiating between reconstruction of veridical and induced or false memories, (2) a person's memory of the self and its past, which is noncontextual by ontogenetic definition, could be more determined by the hedonistic dimensions of word meanings than previously anticipated, and (3) therapists who behave operationally as the patient's prefrontal lobes (particularly when the patient is mildly depressed and exhibits a fragile sense of self) may have an extremely powerful influence upon the emotional dimensions of the words that determine the patient's reconstruction (and hence images) of past events.

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